

BROKERING OF INFORMATION ACQUISITION BY DEVICES IN A WIRELESS NETWORK

This invention relates to information acquisition by devices in a wireless network. It especially, but not exclusively, relates to advertising over a wireless network, and is especially useful in short range networks, such as Bluetooth^(TM).

There has long been a desire to advertise goods or information on networks, usually to be exchanged for money. Spam e-mails are a fact of life, as are television advertisements and radio advertisements. Advertisements on video screens in buildings, whilst waiting in queues, and even in washrooms are known. There is so much advertising it is losing its effect on people, and people can switch off their interest as soon as they realise they are receiving an advertisement, and not pay any attention to it. This directs advertisers to use short advertisements. On the other hand, someone who is actually considering a purchase, the very person an advertiser would like to contact, may want more information to assist them.

Another problem with advertising to a mass market is that the supply of goods, or special deals, may have been exhausted by the time that a recipient of the advertisement replies to the advertisement. This can be annoying to the prospective customer. Furthermore, the usefulness of a special deal may be somewhat limited to certain customers (e.g. cheap flights from Chicago to New York may not be interesting to some one who lives in Los Angeles).

A further form of advertising is unsolicited cold-calling at a persons house, e.g. at the doorstep, or unsolicited telephone calls to try to persuade a person to buy something. This can be quite disturbing to the recipient of these personal unsolicited approaches.

There are, of course, many other forms of advertising.

It is an aim of at least one embodiment of the invention to at least try to ameliorate at least one of the aforesaid problems.

According to a first aspect the invention comprises a method of advertising comprising:

broadcasting a short range advertisement from an advertiser telecommunications device;

receiving the broadcast advertisement on a consumer telecommunications device; and

replying to the advertisement via a broker device interposed in the telecommunications link between the advertiser device and the consumer device.

Thus the broker device is interposed between advertiser and consumer devices and can control what is communicated between them. It is therefore possible for the broker device to modify the message sent by the consumer device to the advertiser device, and/or to modify any follow-up message sent by the advertiser device, or a proxy or master advertising device, to the consumer device. The advertiser device may or may not include its own telecommunications address in its broadcast advertisement. It may include the telecommunications address of the broker device.

Short range is typically a few metres to something of the order of ten metres. Long distance can be of the order of a mile or miles, tens of miles, or hundreds of miles, or more.

The method may include broadcasting an advertisement including one or more advertisement classification codes which are compared with allowable advertisement codes in an advertisement screening operation by the consumer device. The consumer device may store or bring to the attention

of user only those advertisements which are passed by the screening operation that it performs on the broadcast advertisements that it receives.

The consumer device may reply to an advertisement via short range, e.g. piconet, telecommunications, or via long range, e.g. cellular telephone, telecommunications. It may be preferred to reply to an advertisement via long range telecommunications because it may avoid the advertiser device knowing that the consumer device is close. The communication between the consumer device and the broker device, and/or the communication between the advertiser device and the broker device may be via long range telecommunications.

The method may comprise sending a first part of an advertisement via the short range telecommunications, and a second, preferably longer or larger, part of the advertisement via either long range or short range telecommunications. The first part may comprise substantially any advertisement classification codes. The second part may have 5, 10, 50, 100, or more, times as much data as the first part of the advertisement. The second part of the advertisement may be transmitted after the consumer device has screened the first part of the advertisement and communicated with the advertisement broker device or with the advertising device. The second part of the advertisement may be broadcast by the same advertiser device that broadcast the first part, or by a different advertiser telecommunications device.

Preferably the consumer telecommunications device is a portable, preferably a hand-portable, or pocketable, device. Preferably the advertiser device is a portable, preferably hand-portable, or pocketable, device (i.e. can be put in a normal pocket of normal clothing). One or both of the advertiser and consumer devices may comprise a mobile telephone or Personal Digital Assistant (PDA). The mobile device(s) is/are preferably

portable electronic devices, which preferably have both piconet short range and long range telecommunication capabilities.

The advertisement, or first part or second part of the advertisement, may comprise an offer to sell or to buy; or it may comprise data or information that is not normally considered advertisements, for example documents or information. The method is especially useful to disseminate short-form abstracts of documents prior to a user deciding if they wish to call down longer versions/more information.

The same device may be both a consumer and advertiser device. It can be advertising one or more different advertisements and willing to consume incoming advertisements, possibly a user set profile of incoming advertisements. It may advertise and consume simultaneously, or substantially simultaneously.

It will be appreciated that by using a broker device interposed between the advertiser device and the consumer device, the consumer device may be pre-loaded with a telecoms address for the broker device and the advertisement transmitted by the advertiser device may not need to include a telecoms address for the broker device (or its own address). This can reduce the data transmitted in the advertisement a little. Furthermore, the consumer device does not have to have an automatic address-selection/entering capability for variable advertisement follow-up addresses (which would be the case if the consumer device replied directly to the advertiser device over the cellular network). Many, many, mobile telephones, or devices, may be pre-loaded with the same broker device address. A refinement is of course that there may be a plurality of different broker devices, each with their own telecoms address, and the advertisement could simply flag which of the pre-loaded addresses to use (instead of containing the full address). Much of the complexity of the

processing is moved to the broker device, which allows simpler and cheaper advertiser and/or consumer devices.

It will be appreciated that whilst it is envisaged that “advertisement” will usually be something offered for monetary recompense, it may not always be so. For example, it is possible that the advertisement may comprise a circulation of the titles or abstracts of recently published papers or internal news, and the “reply to advertisement” may be a request for the full copy of the documents, with or without payment; the advertisement may comprise a request for volunteers to perform a task, and the reply may be volunteers agreeing to perform the task and enquiring more about what is expected of them.

The invention may be seen as a way of telecommunication devices acquiring information.

Embodiments of the invention will now be described by way of example only, with reference to the accompanying drawings, of which:-

Figure 1 shows schematically two mobile telephones in accordance with the invention;

Figure 2 schematically illustrates the invention;

Figure 3 is a flow diagram illustrating one way of implementing an aspect of the invention;

Figure 4 is a flow diagram illustrating one way of implementing the playback of a captured advertisement;

Figure 5 schematically illustrates one way that an advertising person can create their advertisement;

Figure 6 schematically illustrates one way that a person can configure their mobile telephone to screen out unwanted advertisements;

Figure 7 schematically shows a building with a point of high human traffic flow provided with an advertising station;

Figure 8 shows the visual display of a mobile telephone with some advertisements accepted on it; and

Figure 9 schematically shows an advertisement.

Figure 1 shows a first mobile telephone 10, a consumer's telephone, and a second mobile telephone 12, an advertiser's telephone. Both telephones have both short-range (of the order of 10 metres or so) wideband wireless telecommunications capabilities, e.g. Bluetooth or IEEE812.11, provided by short range telecommunication antenna 14a and 14b, and they both also have long range cellular telecommunications capabilities provided by long range antenna 16a and 16b. Both telephones also have a control processor 18a or 18b, memory data storage 19a and 19b, a battery 20a or 20b, a keypad or other data input means (e.g. voice recognition) 22a or 22b, a display screen 24a or 24b, a microphone 26a or 26b, and a speaker 28a or 28b.

The two telephones 10 and 12 can communicate in a piconet via their short range telecommunication channels when they are close enough together, and can communicate via their long range antenna 16a and 16b, (and via land emitters and receivers 30, and via satellite 32) at much greater distances apart (miles, hundreds of miles, or thousands of miles apart).

Such telephones may be termed "dual mode" or "hybrid" telephones. It will be appreciated that by "telephone" is meant primarily what is conventionally thought of as being a mobile telephone, but also "mobile telecommunications device", such as a Personal Digital Assistant (PDA), laptop or palmtop computers, or even devices which have other functions, possibly even other primary functions, in addition to having short range and long range telecommunications abilities.

In the example of Figure 1 and as illustrated in Figure 2, telephone 10 is the advertiser's telephone and it has within it an electronic advertisement advertising something for sale (for the sake of example). Phone 10 has its controller 18a and memory 19a arranged so that it broadcasts, referred 34 in Figure 2, periodically, say every 30 seconds, a short-form advertisement, or category of advertisement, using its short range telecommunications antenna 14a. The advertisement is stored in the advertiser telephone memory 19a, as mentioned in Figure 2 at reference 36, and is recalled to an emitter circuit of the telephone periodically for broadcast.

The consumer's hybrid telephone, 12, has an advertisement filter 38 and when it receives the broadcast advertisement 34 it compares its categories or profile permissible parameters with those of its filter 38, and if there is a match to a suitable degree the consumer's telephone 12 sounds or vibrates, or otherwise alerts the consumer to the presence of an advertisement of interest. In an alternative embodiment it does not notify the consumer at this stage.

After the consumer's telephone 12 has determined that the broadcast advertisement is of interest it automatically sends out a signal via its short range telecommunications antenna 146 requesting a full advertisement from the telephone 10 (referenced 40 in Figure 2). Upon receipt of the request for the full advertisement, telephone 10 transmits its full advertisement,

again via its short range telecommunications (referenced 42). If the advertiser telephone 10 is out of piconet range (which is unlikely since the “full advertisement request” is likely to be issued within a second of receipt of the short-form advertisement), or no piconet transmitted full advertisement is received by the consumer phone 12, it may contact the advertiser via its long range telecomms, if the telecomms address of the advertiser is known.

The consumer’s telephone 12 receives the full advertisement and stores it in its memory 19b. At this stage the device 12 notifies the consumer that it has an advertisement of interest (if it has not already done so). Alternatively, the telephone 12 may be configured to alert the consumer only at predetermined times (e.g. the end of the work day, or at lunch time), or at predetermined location (eg. at a consumer’s home, at their office, or perhaps anywhere else but not whilst they are at certain locations (e.g. not in their car when they might be driving, and not in a main meeting room, not in a cinema etc.)

After the consumer has experienced the advertisement (it could be audio, visual, or both) they may wish to reply to the advertisement. They can do this by triggering an automatic reply dial. The advertisement category, short-form advertisement, that has already been received by the consumer’s telephone 12, provided the telephone 12 with the telecommunications address of either the full advertisement, the reply address for the advertisement, or both. Alternatively the reply address may be communicated to the phone 12 by the full advertisement 42. However, the phone 12 becomes aware of the reply address, it sends a reply, referenced 44 and/or 4b in Figure 2.

The phone 12 initially tries to reply to device 10 via the short range telecomms 14a and 14b. If that is successful then the two phones 10 and 12 can continue to communicate over, for example, Bluetooth, or the like.

If no reply connection can be established over the local piconet, the device 12 uses its long range cellular telecommunications ability, via antenna 16b, to reply to the advertisement. This is referenced 46 in Figure 2. In Figure 2 the reply 46 is addressed to an advertisement broker 48 which forwards the reply to the advertiser's telephone 10, possibly after removing data that would enable the device 10 to contact the device 12 directly, e.g. the address of device 10. It may be desirable to do this if the advertiser who is using phone 10 has to pay the advertisement broker to be put in direct contact with the interested customer.

The amount of data, and the content of the data, in the reply 44 or 46 may be constrained by the advertising service provider referenced 50.

When the advertiser agrees to pay the advertisement broker (if this is necessary) the advertisement broker provides the direct telecomms address of the consumer to the advertiser, or of the advertiser to the consumer, or both of their addresses to each other. It will be appreciated that the arrangement may be that the interested consumer may pay/agree to pay instead of or as well as the advertiser before they are put properly directly in touch with each other.

Figure 2 also indicates that the service provider 50 makes available to the advertiser, via their telephone 10, an advertisement writing tool 52. This is used to ensure conformity and standardisation of short-form advertisements 34, or at least of their searchable/filterable categories, so that the filter 38 of the consumer's telephone can find those advertisements that are classed as being in the sought categories and screen out other advertisements.

Figure 3 shows a flow chart process for another embodiment of the invention. In this example the consumer's telephone 12 receives at 60 an advertisement via its short range/high bandwidth telecomms system. The

advertisement, which may simply be the classification categories into which the advertisement falls, or may also include text, audio, or video, is stored in buffer memory temporarily, step 62.

The advertisement is screened, at step 64, against the pre-existing filter profile in the phone 12. If the profile of the advertisement does not match that of the filter to an acceptable degree the consumer is not alerted to the presence of the advertisement, and the advertisement in the buffer memory can be overwritten by future advertisement received by the device 12, or may even be positively deleted. If the advertisement is passed by the filter it is transferred to longer term memory of the phone 12, see step 66.

This embodiment has the feature of being able to alert a consumer of an advertisement very promptly, if appropriate to do so. This may be important if the advertisement has short range (geographical range) applicability, for example a “30% reduction in set meal cost today only” advertisement broadcast by a restaurant, or “upload newspaper now - \$1” broadcast by an electronic news-stand. These are situations where the offer is either of immediate interest to the consumer or not, and there is little point in the consumer discovering some hours later that they could have had a special lunch deal hours ago, but have missed it now.

As illustrated at 68 in Figure 3, one of the advertisement parameters is “urgency”, whether that be time expiry of relevancy of advertisement, or physical location – expiry of relevance of advertisement. The phone 10 may be configured to alert a user straight-away if an advertisement in a non-screened out category is received which has an urgency flag associated with it.

The user can decide whether to play the advertisement now, or save it until later, referenced 70. If the user decides to ignore the advertisement for now they can decide not to play it, and their phone 10 saves it with an

automatic recall function 72 where the advertisement is re-presented on the phone to the user for playing at either a predetermined time later (e.g. 2 hours later, provided replay time is between 8.00am and 10.00pm), or a set event (e.g. 5 minutes after detecting the user's home base beacon at their house, or at their office, or in their car).

Figure 4 illustrates the configuration of one embodiment of the invention, after a consumer has decided to play the advertisement (reference 80). The user may decide to save an advertisement they had played back to them to memory (step 82) or they may leave the advertisement in temporary memory and deal with it/enquire further with the advertisement temporarily stored. Either way, there comes a time when the user would like to reply to the advertisement, or to request more details, step 84. The phone 12 contacts an advertiser device via its long distance telecomms, step 86. This advertiser device could be another mobile device, or the device which transmitted the advertisement (which very well may be a mobile device) or it could be a separate, different, device, e.g. an Application Service Provider Server.

The advertiser device transmits more information to the consumer device 10 via the long distance, e.g. cellular, network. The device 10 saves the expanded advertisement, with the extra information to memory, step 90 (possibly temporary memory, or possibly long term memory). The user can reply to the advertisement via long range telecomms 94.

Figure 5 shows one possible implementation of how an advertiser may create an advertisement on their advertising device. There is an Application Service Provider (ASP) who can be contacted by the advertising device via long range telecomms (e.g. internet or cellular, referenced 106). The advertising person types in their advertisement using free text, step 108, typically via their mobile telephone or PDA. The ASP has an ASP Advertisement Writer Tool which takes the free text

advertisement and, using a set of algorithms and rules, converts it into a constrained format, step 110, where only selected predetermined words can be used in the advertisement, and creates an advertisement classification profile which accompanies the constrained text. The constrained text advertisement and the automatically generated advertisement category profile are presented to the advertiser for review, step 112, possibly along with selected other categories that the user may care to add to the automatically generated categories, or exchange for them. The user may be able to delete or change the automatically generated categories: see step 114. The completed advertisement is then transmitted to an advertising station, see step 116. This advertising station may be the advertiser's device (e.g. phone), or it could be a separate advertiser station, e.g. a site where a lot of people pass by.

Figure 6 shows the setting of an advertisement filter for a mobile phone. The telephone 12 (consumer) telephones the ASP, step 120, and the consumer is presented with a display of possible filter categories, for example: holidays, sport, cars, under \$100, under \$50, \$1000-\$5000, clothes, male/female, age target, geographical vicinity of advertiser to be within specific distance of consumer phone (GPS/position sensors may be provided, or just short range capabilities may set the allowable geographic spectrum), food, financial, news, music etc.

The user selects, in step 122, which categories are to be excluded and which are to be included. In this example the ASP gives weightings to other non-specifically indicated categories, dependant upon what has been screened positively in and out of the filter profile, and may pass to the consumer non-specifically screened in, or screened out, advertisements that have a high enough weighting/point score. In this example the user is required specifically to select whether to allow urgency flags to trigger an immediate advertisement alert (if the advertisement if the advertisement passes the rest of the filter) or not, step 124.

When the user has set their filter profile on the ASP it is downloaded from the ASP to the phone, step 126, and the user disconnects from the ASP.

Figure 7 shows one possibility. A user 130 and their mobile phone 132 are in a shopping mall 134 and as they pass a bookstore 134 an advertiser device 136 broadcasts an advertisement on a short range wideband emitter to the mobile phone 132. The advertisement offers a special deal on certain books, e.g. the top 10 best sellers, if the books are bought in the next few hours or days.

The advertiser device 136 (or a similar device associated with another organisation, not necessarily the example given) may emit electronic vouchers or coupons, redeemable against certain goods or services, possibly with a time expiry date.

It will be appreciated that a static advertiser device can reach a lot of people if it is in a busy place such as a shopping mall, turnstile or doorway of a building, or a transport station, such as a train or subway station. A mobile advertiser station, e.g. in a train or taxi, or even carried by a person (e.g. their mobile phone) may be in piconet contact with a great many other devices over a period of time.

Some advertisers may pay some people or organisations to carry their advertisements. For example a company may agree to contribute to a mobile telephone bill if the mobile telephone carries their advertisement and broadcasts it. An amount per enquiry originating from their telephone, or a "rental" fee payable to the owner of the device may be envisaged.

The advertisement could be on offer to sell or supply, or a request to buy or receive.

It will also be appreciated that it may be preferred in some situations to ensure that the reply to an advertisement is transmitted via long range telecommunications, or at least not let the advertiser know that the reply has come via short range telecomms. It can be awkward for a potential customer if a seller/advertiser knows that there is such a potential customer (i.e. someone whose telecomms device has replied to their advertisement) within a few metres of them – in a piconet with them.

The advertisement may take the form of an auction, or reverse auction. An item may be open for bids for a fixed time period and then sold to the highest bidder (or in the reverse auction scenario, the lowest bidder).

A benefit of using a wideband link for the short-form advertisement is that it makes the transmission time of a short form advertisement short, for example less than one second is envisaged. The transmission of the full advertisement and associated details, over Bluetooth or other short range telecomms, might be of the order of a few seconds. The data rate envisaged for the short range telecomms is of the order of 500 kbits/second or better. Perhaps ten times that, or better can be achieved. Video clips may be transmitted.

The short range wideband link may have a data rate that is perhaps 10 to 1000 times as great as that of the long distance telecomms link. In an alternative embodiment the data rates may vary by a factor of <2 , 2, 5, 10, 50, 100, 500, 1000, or more, or by an amount defined by a range between any of those values.

Although primarily described in relation to advertisements, the invention is potentially applicable to other situations where a first tranche of data is provided to a user who may or may not want a further tranche of data, for example abstracts of documents may be distributed via short range piconet links, with users able to obtain fuller text via long range telecomms (and

there may or may not be a cost payable to the host/ASP/database for the fuller text).

The fact that the piconet advertisements are necessarily originating from a local source may be attractive. The invention may be thought of as the broadcasting and filtering of local advertisements over a piconet, with the probable provision of a writing tool (e.g. WAP based) and the possible provision of a broker for responses to advertisements that come back via the cellular network or piconet.

Figure 8 shows a mobile telephone 140 having an LCD display 142. There are five advertisements currently in the memory of the phone 140, and being displayed on display 142. These advertisements are short-form, category-only advertisements. The phone 142 is still in piconet contact with the advertiser device(s) that is/are transmitting the short-form advertisements. The user selects which advertisement to enquire about by using the up/down controls 144, 146 and, in this example chooses advertisement number 3, Parking Availability. Local. In this example those advertisements which carry a "local" flag/characteristic have "local" next to them on the display 142 so that the user can tell they are local.

The user presses the "send" button 148 (or "yes" button) when advertisement 3 is selected and the phone 140 transmits a piconet signal broadcast generally. The piconet advertiser device that is advertising parking space then sends back details of where the parking space is, and how much it costs. In this example the advertiser device does not make a charge for fleshing out the short-form advertisement. The user can now drive to the car parking space knowing that it is close. Whilst each piconet device has a range of the order of a few metres to tens of metres, a piconet in a city, for example, could extend hundreds of metres due to piconet devices passing on messages to other piconet devices in the piconet. Thus

the car parking space can be much further away from the phone 140, even if the advertising device is in the car park (which it need not be).

Item 5 on the display 142 illustrates another characteristic label that may be displayed with the short form advertisement: whether the advertisement is from a commercial organisation or a private individual (i.e. word "PRIVATE" indicates private individual's advertisement).

Figure 9 shows an advertisement 150 having text 152 to be displayed on the screen of a consumer's telephone, and classification codes 154 that are not displayed, but that are used by the advertisement filter of the consumer's phone to determine whether the consumer wishes to know about the advertisement. It has both "SELL" and "BUY" codes since the advertiser is both looking to part with a dog and to acquire toys.

The phone 140 presents the advertisement categories 1 to 5 initially as text only. The list of advertisements on its display may be a limited number of advertisements, limited to the best matches to the filter. The list may be a rolling list which is scrollable through advertisements received, either manually scrollable or automatically scrolling. The phone may have no filter.

To return to an overview of embodiments of the invention: It will be apparent that the advertisement of short range high bandwidth wireless technologies such as Bluetooth will give rise to a new class of hybrid mobile phones that combine both a long range cellular link with a separate short range wireless link in the same device. With such hybrid phones, it will be possible to communicate via the cellular link, passing information received directly on through the short range link to nearby devices, and vice-versa. The present invention takes advantage of this to provide an advertisement service that uses these hybrid phones to broadcast

advertisements, receive advertisements and respond to these advertisements.

The advertiser preferably broadcasts only a minimal advertisement to those in the vicinity, typically the advertisement category. If there is a match of interest in the consumer's phone, the consumer's phone then requests the full advertisement details which are quickly transferred over the short range link. This "advertisement transaction" will happen very quickly, and because of the short range communication that is used, by the time the consumer has had time to consider the advertisement the advertiser may be out of range. Thus, there is proposed a response route via the long range cellular network. The consumer indicates on his phone his desire to purchase the item, and signals this back via the cellular network. The advertisement broker matches the ID of the advertisement with that of the advertiser and passes on a message to the advertiser informing him of the consumer's interest.

The wireless nature of the short and long range telecomms envisaged is attractive.

The service provider, or advertising device could provide an auction, or other value-added services.

Each mobile phone or PDA could be viewed as a walking billboard. It is of course possible to configure a phone to respond to accept no advertisements.

It will be appreciated that in the prior art a user who wants to have details of a lot of documents/data (e.g. advertisements) from a remote site has been able to transmit the database to themselves and to discard what they do not want. This is very wasteful in telecommunication capacity and requires a great deal of bandwidth, and also a lot of memory at the receiving device.

The present invention reduces the amount of data that is carried via telecommunications, and that is stored (albeit temporarily), in comparison with transferring everything and then discarding at the user's end.

An alternative known system is for a user to type in a search strategy to a computer to instruct a remote database host to perform a search for the data of interest and to transmit to the user via telecommunications just the result of the database search. However, this does not lend itself very well to the situation such as advertising where a user does not know that there is data that they might like to see (because they would not know to type in an appropriate search command). Some embodiments of the present invention positively, and proactively, draws to the attention of a user opportunities to discover more about a data record.

Some embodiments of the invention transmit relatively large volumes of data over high bandwidth, cheap (or even free-to-air) short range wireless transmissions. This avoids congesting land lines, or long range cellular networks. These embodiments may restrict the use of the long range wireless telecommunications, which typically are more expensive in transmission costs and are often more congested, to smaller volumes of data, and/or to data that is known to be of interest (rather than speculative unsolicited data). This can improve the overall availability of the long distance e.g. cellular network, the connection rate for successful connections, and can reduce the rate for connections being unexpectedly terminated.

By having the advertisement writer and filter creator at a remote site, the mobile consumer and advertiser devices can potentially have simpler microprocessors/software stored on them, and require less processing power and memory than they otherwise would, since the software and databases used to create the advertisements and filters need not be stored in them, or be operable in their processor chips.

By having advertisements, or other data, broadcast at low power over a short range piconet by an advertiser device (e.g. mobile telephone), it is possible to avoid using high power, longer distance, transmitters, and the power density of radiation in the environment may be kept down (in comparison with having a big long range transmitter). This may help reduce electromagnetic "pollution" of the electromagnetic environment, and may reduce the likelihood of signals interfering with other things undesirably.

11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
101
102
103
104
105
106
107
108
109
110
111
112
113
114
115
116
117
118
119
120
121
122
123
124
125
126
127
128
129
130
131
132
133
134
135
136
137
138
139
140
141
142
143
144
145
146
147
148
149
150
151
152
153
154
155
156
157
158
159
160
161
162
163
164
165
166
167
168
169
170
171
172
173
174
175
176
177
178
179
180
181
182
183
184
185
186
187
188
189
190
191
192
193
194
195
196
197
198
199
200
201
202
203
204
205
206
207
208
209
210
211
212
213
214
215
216
217
218
219
220
221
222
223
224
225
226
227
228
229
230
231
232
233
234
235
236
237
238
239
240
241
242
243
244
245
246
247
248
249
250
251
252
253
254
255
256
257
258
259
260
261
262
263
264
265
266
267
268
269
270
271
272
273
274
275
276
277
278
279
280
281
282
283
284
285
286
287
288
289
290
291
292
293
294
295
296
297
298
299
300
301
302
303
304
305
306
307
308
309
310
311
312
313
314
315
316
317
318
319
320
321
322
323
324
325
326
327
328
329
330
331
332
333
334
335
336
337
338
339
340
341
342
343
344
345
346
347
348
349
350
351
352
353
354
355
356
357
358
359
360
361
362
363
364
365
366
367
368
369
370
371
372
373
374
375
376
377
378
379
380
381
382
383
384
385
386
387
388
389
390
391
392
393
394
395
396
397
398
399
400
401
402
403
404
405
406
407
408
409
410
411
412
413
414
415
416
417
418
419
420
421
422
423
424
425
426
427
428
429
430
431
432
433
434
435
436
437
438
439
440
441
442
443
444
445
446
447
448
449
450
451
452
453
454
455
456
457
458
459
460
461
462
463
464
465
466
467
468
469
470
471
472
473
474
475
476
477
478
479
480
481
482
483
484
485
486
487
488
489
490
491
492
493
494
495
496
497
498
499
500
501
502
503
504
505
506
507
508
509
510
511
512
513
514
515
516
517
518
519
520
521
522
523
524
525
526
527
528
529
530
531
532
533
534
535
536
537
538
539
540
541
542
543
544
545
546
547
548
549
550
551
552
553
554
555
556
557
558
559
560
561
562
563
564
565
566
567
568
569
570
571
572
573
574
575
576
577
578
579
580
581
582
583
584
585
586
587
588
589
590
591
592
593
594
595
596
597
598
599
600
601
602
603
604
605
606
607
608
609
610
611
612
613
614
615
616
617
618
619
620
621
622
623
624
625
626
627
628
629
630
631
632
633
634
635
636
637
638
639
640
641
642
643
644
645
646
647
648
649
650
651
652
653
654
655
656
657
658
659
660
661
662
663
664
665
666
667
668
669
670
671
672
673
674
675
676
677
678
679
680
681
682
683
684
685
686
687
688
689
690
691
692
693
694
695
696
697
698
699
700
701
702
703
704
705
706
707
708
709
710
711
712
713
714
715
716
717
718
719
720
721
722
723
724
725
726
727
728
729
730
731
732
733
734
735
736
737
738
739
740
741
742
743
744
745
746
747
748
749
750
751
752
753
754
755
756
757
758
759
760
761
762
763
764
765
766
767
768
769
770
771
772
773
774
775
776
777
778
779
780
781
782
783
784
785
786
787
788
789
790
791
792
793
794
795
796
797
798
799
800
801
802
803
804
805
806
807
808
809
810
811
812
813
814
815
816
817
818
819
820
821
822
823
824
825
826
827
828
829
830
831
832
833
834
835
836
837
838
839
840
841
842
843
844
845
846
847
848
849
850
851
852
853
854
855
856
857
858
859
860
861
862
863
864
865
866
867
868
869
870
871
872
873
874
875
876
877
878
879
880
881
882
883
884
885
886
887
888
889
890
891
892
893
894
895
896
897
898
899
900
901
902
903
904
905
906
907
908
909
910
911
912
913
914
915
916
917
918
919
920
921
922
923
924
925
926
927
928
929
930
931
932
933
934
935
936
937
938
939
940
941
942
943
944
945
946
947
948
949
950
951
952
953
954
955
956
957
958
959
960
961
962
963
964
965
966
967
968
969
970
971
972
973
974
975
976
977
978
979
980
981
982
983
984
985
986
987
988
989
990
991
992
993
994
995
996
997
998
999
1000
1001
1002
1003
1004
1005
1006
1007
1008
1009
1010
1011
1012
1013
1014
1015
1016
1017
1018
1019
1020
1021
1022
1023
1024
1025
1026
1027
1028
1029
1030
1031
1032
1033
1034
1035
1036
1037
1038
1039
1040
1041
1042
1043
1044
1045
1046
1047
1048
1049
1050
1051
1052
1053
1054
1055
1056
1057
1058
1059
1060
1061
1062
1063
1064
1065
1066
1067
1068
1069
1070
1071
1072
1073
1074
1075
1076
1077
1078
1079
1080
1081
1082
1083
1084
1085
1086
1087
1088
1089
1090
1091
1092
1093
1094
1095
1096
1097
1098
1099
1100
1101
1102
1103
1104
1105
1106
1107
1108
1109
1110
1111
1112
1113
1114
1115
1116
1117
1118
1119
1120
1121
1122
1123
1124
1125
1126
1127
1128
1129
1130
1131
1132
1133
1134
1135
1136
1137
1138
1139
1140
1141
1142
1143
1144
1145
1146
1147
1148
1149
1150
1151
1152
1153
1154
1155
1156
1157
1158
1159
1160
1161
1162
1163
1164
1165
1166
1167
1168
1169
1170
1171
1172
1173
1174
1175
1176
1177
1178
1179
1180
1181
1182
1183
1184
1185
1186
1187
1188
1189
1190
1191
1192
1193
1194
1195
1196
1197
1198
1199
1200
1201
1202
1203
1204
1205
1206
1207
1208
1209
1210
1211
1212
1213
1214
1215
1216
1217
1218
1219
1220
1221
1222
1223
1224
1225
1226
1227
1228
1229
1230
1231
1232
1233
1234
1235
1236
1237
1238
1239
1240
1241
1242
1243
1244
1245
1246
1247
1248
1249
1250
1251
1252
1253
1254
1255
1256
1257
1258
1259
1260
1261
1262
1263
1264
1265
1266
1267
1268
1269
1270
1271
1272
1273
1274
1275
1276
1277
1278
1279
1280
1281
1282
1283
1284
1285
1286
1287
1288
1289
1290
1291
1292
1293
1294
1295
1296
1297
1298
1299
1300
1301
1302
1303
1304
1305
1306
1307
1308
1309
1310
1311
1312
1313
1314
1315
1316
1317
1318
1319
1320
1321
1322
1323
1324
1325
1326
1327
1328
1329
1330
1331
1332
1333
1334
1335
1336
1337
1338
1339
1340
1341
1342
1343
1344
1345
1346
1347
1348
1349
1350
1351
1352
1353
1354
1355
1356
1357
1358
1359
1360
1361
1362
1363
1364
1365
1366
1367
1368
1369
1370
1371
1372
1373
1374
1375
1376
1377
1378
1379
1380
1381
1382
1383
1384
1385
1386
1387
1388
1389
1390
1391
1392
1393
1394
1395
1396
1397
1398
1399
1400
1401
1402
1403
1404
1405
1406
1407
1408
1409
1410
1411
1412
1413
1414
1415
1416
1417
1418
1419
1420
1421
1422
1423
1424
1425
1426
1427
1428
1429
1430
1431
1432
1433
1434
1435
1436
1437
1438
1439
1440
1441
1442
1443
1444
1445
1446
1447
1448
1449
1450
1451
1452
1453
1454
1455
1456
1457
1458
1459
1460
1461
1462
1463
1464
1465
1466
1467
1468
1469
1470
1471
1472
1473
1474
1475
1476
1477
1478
1479
1480
1481
1482
1483
1484
1485
1486
1487
1488
1489
1490
1491
1492
1493
1494
1495
1496
1497
1498
1499
1500
1501
1502
1503
1504
1505
1506
1507
1508
1509
1510
1511
1512
1513
1514
1515
1516
1517
1518
1519
1520
1521
1522
1523
1524
1525
1526
1527
1528
1529
1530
1531
1532
1533
1534
1535
1536
1537
1538
1539
1540
1541
1542
1543
1544
1545
1546
1547
1548
1549
1550
1551
1552
1553
1554
1555
1556
1557
1558
1559
1560
1561
1562
1563
1564
1565
1566
1567
1568
1569
1570
1571
1572
1573
1574
1575
1576
1577
1578
1579
1580
1581
1582
1583
1584
1585
1586
1587
1588
1589
1590
1591
1592
1593
1594
1595
1596
1597
1598
1599
1600
1601
1602
1603
1604
1605
1606
1607
1608
1609
1610
1611
1612
1613
1614
1615
1616
1617
1618
1619
1620
1621
1622
1623
1624
1625
1626
1627
1628
1629
1630
1631
1632
1633
1634
1635
1636
1637
1638
1639
1640
1641
1642
1643
1644
1645
1646
1647
1648
1649
1650
1651
1652
1653
1654
1655
1656
1657
1658
1659
1660
1661
1662
1663
1664
1665
1666
1667
1668
1669
1670
1671
1672
1673
1674
1675
1676
1677
1678
1679
1680
1681
1682
1683
1684
1685
1686
1687
1688
1689
1690
1691
1692
1693
1694
1695
1696
1697
1698
1699
1700
1701
1702
1703
1704
1705
1706
1707
1708
1709
1710
1711
1712
1713
1714
1715
1716
1717
1718
1719
1720
1721
1722
1723
1724
1725
1726
1727
1728
1729
1730
1731
1732
1733
1734
1735
1736
1737
1738
1739
1740
1741
1742
1743
1744
1745
1746
1747
1748
1749
1750
1751
1752
1753
1754
1755
1756
1757
1758
1759
1760
1761
1762
1763
1764
1765
1766
1767
1768
1769
1770
1771
1772
1773
1774
1775
1776
1777
1778
1779
1780
1781
1782
1783
1784
1785
1786
1787
1788
1789
1790
1791
1792
1793
1794
1795
1796
1797
1798
1799
1800
1801
1802
1803
1804
1805
1806
1807
1808
1809
1810
1811
1812
1813
1814
1815
1816
1817
1818
1819
1820
1821
1822
1823
1824
1825
1826
1827
1828
1829
1830
1831
1832
1833
1834
1835
1836
1837
1838
1839
1840
1841
1842
1843
1844
1845
1846
1847
1848
1849
1850
1851
1852
1853
1854
1855
1856
1857
1858
1859
1860
1861
1862
1863
1864
1865
1866
1867
1868
1869
1870
1871
1872
1873
1874
1875
1876
1877
1878
1879
1880
1881
1882
1883
1884
1885
1886
1887
1888
1889
1890
1891
1892
1893
1894
1895
1896
1897
1898
1899
1900
1901
1902
1903
1904
1905
1906
1907
1908
1909
1910
1911
1912
1913
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
1924
1925
1926
1927
1928
1929
1930
1931
1932
1933
1934
1935
1936
1937
1938
1939
1940
1941
1942
1943
1944
1945
1946
1947
1948
1949
1950
1951
1952
1953
1954
1955
1956
1957
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
2041
2042
2043
2044
2045
2046
2047
2048
2049
2050
2051
2052
2053
2054
2055
2056
2057
2058
2059
2060
2061
2062
2063
2064
2065
2066
2067
2068
2069
2070
2071
2072
2073
2074
2075
2076
2077
2078
2079
2080
2081
2082
2083
2084
2085
2086
2087
2088
2089
2090
2091
2092
2093
2094
2095
2096
2097
2098
2099
2100
2101
2102
2103
2104
2105
2106
2107
2108
2109
2110
2111
2112
2113
2114
2115
2116
2117
2118
2119
2120
2121
2122
2123
2124
2125
2126
2127
2128
2129
2130
2131
2132
2133
2134
2135
2136
2137
2138
2139
2140
2141
2142
2143
2144
2145
2146
2147
2148
2149
2150
2151
2152
2153
2154
2155
2156
2157
2158
2159
2160
2161
2162
2163
2164
2165
2166
2167
2168
2169
2170
2171
2172
2173
2174
2175
2176
2177
2178
2179
2180
2181
2182
2183
2184
2185
2186
2187
2188
2189
2190
2191
2192
2193
2194
2195
2196
2197
2198
2199
2200
2201
2202
2203
2204
2205
2206
2207
2208
2209
2210
2211
2212
2213
2214
2215
2216
2217
2218
2219
2220
2221
2222
22